which Sir David Gill was himself the first to direct attention. And he has completely photographed, on a moderate scale, the Southern Hemisphere. The plates were measured in Holland by Kapteyn, who has published the results recently in a valuable work, the "Cape Photographic Durchmusterung," for which Kapteyn received the Royal Astronomical Society's Gold Medal in February, 1902. It may be recalled that on that occasion Kapteyn expressed very warmly his indebtedness to Sir David Gill.

Sir David Gill had a large share in initiating the International Astrographic Chart; he has also been very active in superintending the Geodetic Survey in South Africa.

ROYAL MEDAL.

The other Royal Medal is conferred upon Dr. Horace T. Brown, F.R.S., for his work on the chemistry of carbohydrates, and on the assimilation of carbonic acid by green plants.

His memoir (H. T. Brown and G. H. Morris, *Journ.* Chem. Soc., 1893) on the "Chemistry and Physiology of Foliage Leaves" is of value as confirming the rougher work of Sachs on the amount of carbohydrate assimilated per leaf area per unit of time, but especially as being the first thorough investigation into the manufacture and translocation of the various sugars in the green leaf. This paper also contributes to our knowledge of the action of diastase in the leaf; and in this connection may be mentioned the paper on the "Germination of the Gramineæ" (H. T. Brown and G. H. Morris, *Journ.* Chem. Soc., 1890), which is a valuable contribution to the study of diastase and other enzymes.

His Presidential Address to the Chemical Section of the British Association, 1899, gave an account of work of the highest interest to botanists, such as the relation between the amount of assimilation of carbon and the partial pressure of the carbonic acid in the atmosphere, and the rate of absorption of carbonic acid by a leaf, as compared with the absorption by a solution of caustic alkali. These and other points are developed in the memoir on "Static Diffusion of Gases and Liquids in Plants" (H. T. Brown and F. Escombe, *Phil. Trans.*, 1900), which is one of the most important works on assimilation by plants that we possess. In this remarkable essay, Brown develops the principles determining the amount of diffusion from gases and solutions into absorbing surfaces, and shows that leaves conform in the size and number of the stomata to absorbing surfaces of high efficiency.

The earliest important chemical work of Horace Brown was on the influence of pressure on fermentation. He discovered that other gases besides carbonic acid were given off in the fermentation of malt worts and of grape sugar, and that the hydrogen evolved increased as the pressure was diminished. The formation of acetic acid during the fermentation out of contact with air was shown to be due to a direct transformation of the sugar into acetic acid.

In conjunction with Heron and Morris, he made a series of valuable investigations into the nature of starch and its transformations. He showed that the action of malt extract upon soluble starch might be represented by the *successive* removals of maltose by hydration (hydrolysis), the successively formed residues being a series of dextrins.

He was the first to apply Raoult's freezing-point method to the systematic determination of the molecular weights of the carbohydrates, and his measurements showed that soluble starch was much more complicated than the dextrins derived from it, the starch molecule possibly consisting of four complex amylin-groups arranged round a similar fifth group. But later work on dextrinic acid led to the view that the starch molecule is made up of the residues of 80 *maltan* groups and 40 *dextran* groups, linked in ring form through oxygen atoms, and that the maltan portion of the ring is attacked by successive stages of hydrolysis, forming dextrins and finally maltose. The molecular weight of starch cannot be less, according to these experiments, than 32,400.

The investigation of "secondary fermentation" produced by a small quantity of dried hops in beer led to his important work on the chemistry and physiology of foliage leaves, in which he gives reasons for supposing that cane-sugar is the first sugar to be synthesised by the assimilatory processes, and that this is the starting point of the metabolic changes in the leaf.

The discovery of the solution of the cell-membranes of grass seeds by a cellulose-dissolving enzyme secreted in the epithelium led him to investigate the corresponding action on the cell-walls of starch granules in the processes of animal digestion. After exhaustive experiments, he concluded that the cell-walls were attacked by an enzyme pre-existent in the grain.

DAVY MEDAL.

The Davy Medal for the most important discovery in chemistry is awarded to M. Pierre Curie, and Madame Curie, Docteur ès Sciences, for their researches on radium.

The discovery of radium—whether it be regarded from the point of view of the extraordinary properties of that substance, unique in their intensity if not in their kind, or of the undeviating aim and invincible patience with which the clue to its separation has been skilfully followed, or of the extended, even revolutionary, views of the constitution of matter and of the stores and transformations of energy in Nature which the study of its properties is opening up to us—may well be characterised as the most important discovery in chemistry of the present time.

HUGHES MEDAL.

The Hughes Medal is awarded to Prof. Johann Wilhelm Hittorf for his experimental researches on the electric discharge in liquids and gases, extending over a period of more than half a century into the present year.

The results of his work have been published in a series of papers, of which the first, on the electric conductivity of mercury, appeared in *Poggendorff's Annalen* so long ago as 1851, and was followed, in the years 1853 to 1859, by others, giving an account of his masterly investigations of the migrations of the ions in electrolysis. In conjunction with Plücker he took up the examination of the spectra emitted by gases under the influence of electric discharges from an induction coil, and communicated the results to the Royal Society in 1864; and in the ensuing twenty years he published, from time to time, a number of papers on electric conductivity in gases, which have greatly contributed to the advancement of our knowledge of that subject. In 1898 and 1899 he published papers on the electromotive behaviour of chromium and on the passive state of metals, and in the three years of the present century further papers on the rates of motion of the ions.

It is now the jubilee of the publication of his first paper on the last-named subject, a paper which marks an epoch in our knowledge of electrolysis. In that paper, and those which followed it in the next five years, by his careful measurements of the movements of the ions in a great variety of cases, he laid a solid foundation on which subsequent investigators have reared a large superstructure. The view of the constitution of electrolytes, and of chemical compounds in general, to which his research directly led, was so contrary to that in vogue amongst chemists at that time that it challenged opposition, but time has vindicated its accuracy and importance. His researches on electric conductivity in gases have been almost equally fruitful, for they have served as the starting point from which other observers have advanced, and have thus led up to modifications of our ideas of the constitution of matter quite as profound as those suggested by the migrations of the ions.

PROF. ROBERT HENRY THURSTON.

BY the death of Prof. Robert Henry Thurston, which occurred with tragic suddenness on his birthday, October 26, the United States has lost its most distinguished engineering professor, and a devoted educationist whom it will be difficult to replace.

He was born at Providence, Rhode Island, in 1839, and was the son of Robert L. Thurston, the founder of the Providence Steam Co. His early training was of that twofold character which has been so much discussed during the last year or two, a collegiate education at the Brown University, where he gradu-

ated C.E., Ph.B., in 1859, and a practical training during the same time in the workshops of his father's firm.

In 1861 he entered the United States Navy, serving from 1861–1865 first as assistant engineer and then as engineer in charge of vessels; this period covered the great Civil War, and the unique experience which Thurston then enjoyed no doubt did much towards turning his mind to experimental research, and probably altered the whole course of his life's work.

In 1865 he was appointed assistant professor of natural philosophy in the United States Naval Academy at Annapolis, and as his chief died a few weeks afterwards, Thurston had entire charge of the department until he resigned the post, in 1871, in order to take up the duties of professor of mechanical engineering in the Stevens Institute of Technology, an office he held until 1885.

It was while he held this chair that Thurston began to make his name known, not only in America, but in Europe; he was a prolific writer on technical subjects, and did much valuable research work in connection with the U.S. Board appointed to deal with the subject of testing metals, notably in the investigation of the properties of the various alloys of copper, tin, and zinc. During this period he also visited Europe as the U.S. Commissioner to the Vienna Exposition of 1873, and on his return published a valuable report.

In 1885 he took up the post which he held until his death, that of director of Sibley College; here he had full scope for his remarkable powers as a teacher and an organiser of scientific education of the most advanced character, and the most eloquent testimony to his success is the extraordinarily rapid growth in the number of students; from a mere handful in 1885, in eighteen years they have increased to nearly 1000, and Sibley College to-day stands in the very front rank of the great technical colleges of the world devoted to the scientific training of the men who are to be the leaders of the engineering profession in all its branches. Much of its success is due to the fact that he was from the first able to win the sympathy and support of the leading engineers of the States, with the result that the Sibley College graduates never find the least difficulty in securing paid posts as soon as they finish their college training.

Thurston altogether wrote some 20 volumes and more than 300 separate scientific papers; his fertility with the pen, when one considers the labours he daily went through as a teacher and director, is amazing, and some of his books bear traces of the haste and pressure under which they were produced.

Of his books, the most noteworthy are the following:—"Friction and Lost Work," "The Materials of Engineering," "A Manual of the Steam Engine," "Steam Boiler Construction," and "A History of the Steam Engine"; these are all in America recognised as standard works, and have found a ready sale also in this country. In fact, Thurston almost attained the same position as was held by Rankine for so many years in this country, and his books were consulted and used by thousands of young engineers scattered throughout the length and breadth of the great Republic.

Thurston was naturally the recipient of many honours; he was the first president of the American Society of Mechanical Engineers, holding office from 1880 to 1883, vice-president of the American Association for the Advancement of Science in 1877, 1878, and 1884, an LL.D. of the Brown University in 1889, &c.; he was twice married, in 1865 to Susan Taylor Gladding (she died in 1878) and in 1880 to Leonora Boughton.

Though Thurston devised several special forms of testing machines, he was not an inventive genius, and he did no work as a constructive engineer. It was as a writer and speaker that he made his influence felt, and how great that influence was will only be fully realised now that he has gone. T. H. B.

SIR FREDERICK BRAMWELL, F.R.S.

THE death of Sir Frederick Bramwell on Monday deprives engineering of one of its most energetic workers, and pure science of one who did much to promote its interests.

Sir Frederick Bramwell was born in London on March 7, 1818, and was apprenticed to one of the old school of mechanical engineers when he was sixteen years of age. After a varied experience he commenced practice on his own account as a civil engineer in 1853, and the following year became a member of the Institution of Mechanical Engineers. He was elected an associate of the Institution of Civil Engineers in 1856; and in 1862 attained full membership.

In 1874 Bramwell was chosen president of the Institution of Mechanical Engineers, and delivered an address in which he appealed to engineers to use to their utmost, and to use fairly, the natural resources at their command. As president of the Institution of Civil Engineers in 1884, he described in his address the chief factors of past progress, and advocated the treatment of large steel forgings by hydraulic pressure in place of steam hammers. He was president of the Mechanical Science Section of the British Association in 1872, and again at Montreal in 1884. He was elected president of the Association for the Bath meeting in 1888, when he delivered an address on the greatness of the works which the engineer creates out of minute beginnings.

Sir Frederick Bramwell received many marks of recognition from public bodies and learned societies. In 1873 he was elected a Fellow of the Royal Society. In 1881, the *Times* relates, he was appointed member of the Ordnance Committee, and in that capacity assisted in the framing of the rules under which iron and steel for the construction of large ordnance are tested before acceptance. After serving on the council and as a member of the board of management he was, on the retirement of Sir William Bowman in 1885, made honorary secretary of the Royal Institution. Always cordially lamenting the lack of facilities for technical education in his youth, he was a warm supporter of the movement for its advancement in this country. On the foundation of the City and Guilds of London Institute he was appointed by the Goldsmiths' Company one of its representatives on the governing body. A knighthood was conferred upon him in 1881, and a baronetcy in 1889. He received the honorary degree of D.C.L. from the Universities of Oxford and Durham, and that of LL.D. from Cambridge and McGill.

NOTES.

PROF. LUDWIG BOLTZMANN has been elected honorary member of the Moscow Academy of Sciences.

THE deaths are announced of Prof. Heinrich Moehl, director of the meteorological station at Cassel, at the age of seventy-one, and Dr. Nagel, formerly professor of geodesy in the technical high school at Dresden.

THE next meeting of the American Association for the Advancement of Science, and affiliated societies, will be held at St. Louis during convocation week beginning on